

We completed testing of cavity NR-1 (Niowave-Roark #1, hereafter referred to as TE1NAR001) today. The cavity performance was rather poor (as evidenced by Figure 1.). At 2K the cavity exhibited quenches at 6, 7.2, and eventually 8.5MV/m. The quenches at lower fields (6 & 7.2 MV/m) were due to FE or MP, and processed thru rather quickly. However, the quench at 8.5MV/m did not show signs of significant processing. There was no radiation observed at the 6 and 7.2MV/m quenches, but radiation was observed beginning at 8.2MV/m. The maximum radiation level was not terribly high – just 3.1×10^{-2} mR/hr – about twice the natural background.

It is not immediately clear if the quench origin is due to FE or MP. Heavy FE could be the cause of the quenches, even though little radiation was observed, if the direction of the radiation was downwards, and not detected by the probe on the top of the dewar top plate. The transmitted power signals did not have the typical “micro-quenching” structure that is usually (but not always) seen when the cavity is in a MP barrier. Furthermore, when incident power was raised, the transmitted power would also rise monotonically until the cavity quenched. When in a MP barrier, one would see the transmitted power reach a plateau (saturation) indicating the onset of the MP barrier, while incident power was still increasing. This effect was not observed and, hence, FE may be more strongly indicated as the quench origin.

In addition to Q_0 vs E at 2K, we also measured Q_0 (R_s) vs T from 4.4K to 1.5K, and the data are shown in Figure 2. The lowest measured R_s was $7.1\text{ n}\Omega$ at 1.5K. This is higher than that measured on cavity TE1AES004 during its first thermal cycle, and slightly higher than that measured on TE1AES004 after it suffered from high FE after being “contaminated”. A “global”, as opposed to discrete, distribution of FE sites could lead to the relatively high R_s seen in TE1NAR001; this has been seen in the past if a HPR water system was contaminated or an EP process was sub-optimum.

An interesting effect can be seen in Figure 3, which shows the data from Figure 2 but expanded around the λ -point of helium. There is a marked discontinuity in R_s across the lambda point (it is slightly shifted from the λ -point marked in green due to small errors in temperature/pressure calibration). This was seen in previous Q vs T measurements of cavities TE1AES004 and Accel06, but a lack of data around the λ -point made it difficult to ascertain. This time, we performed more measurements in the neighborhood of the λ -point to see if it were a repeatable effect. This step-wise change in Q_0 across the λ -point has also been seen before during test performed at JLab (C. Rode et al, “Temperature Optimization of Superconducting Cavities”, IEEE Trans. App. Superconductivity v9, no. 2, June 1999), and was found there to have a magnitude dependant upon cavity gradient. During the measurements of TE1NAR001, the cavity gradient was between 2.3 and 3.3 MV/m in the neighborhood of the λ -point. This discontinuity in Q_0 across the boundary is no doubt related to a change in the nature of heat transfer from the cavity walls into the bath. During future Q_0 vs T measurements, we may, as time allows, attempt to investigate this further by minimizing the dissipated power in the cavity system (performing measurements at even lower gradients, and turning off RF between measurements), or by performing measurements at higher (5-7 MV/m) gradients.

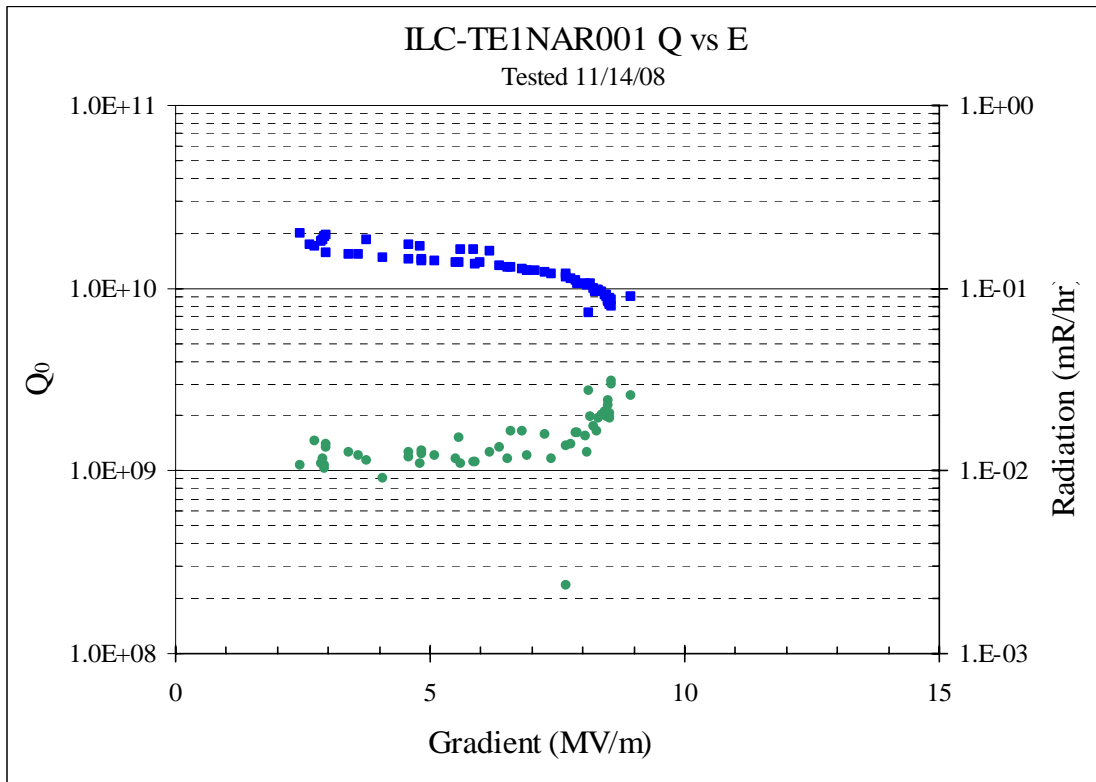


Figure 1.) Q_0 vs E at 2K

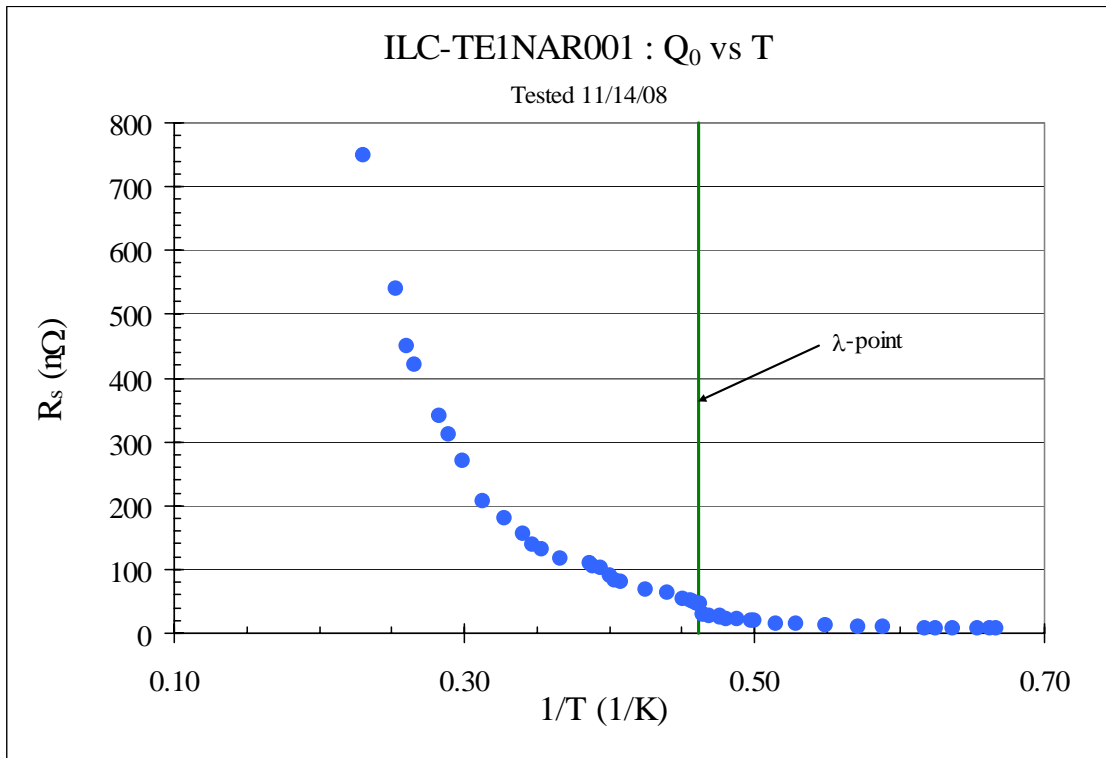


Figure 2.) R_s vs T.

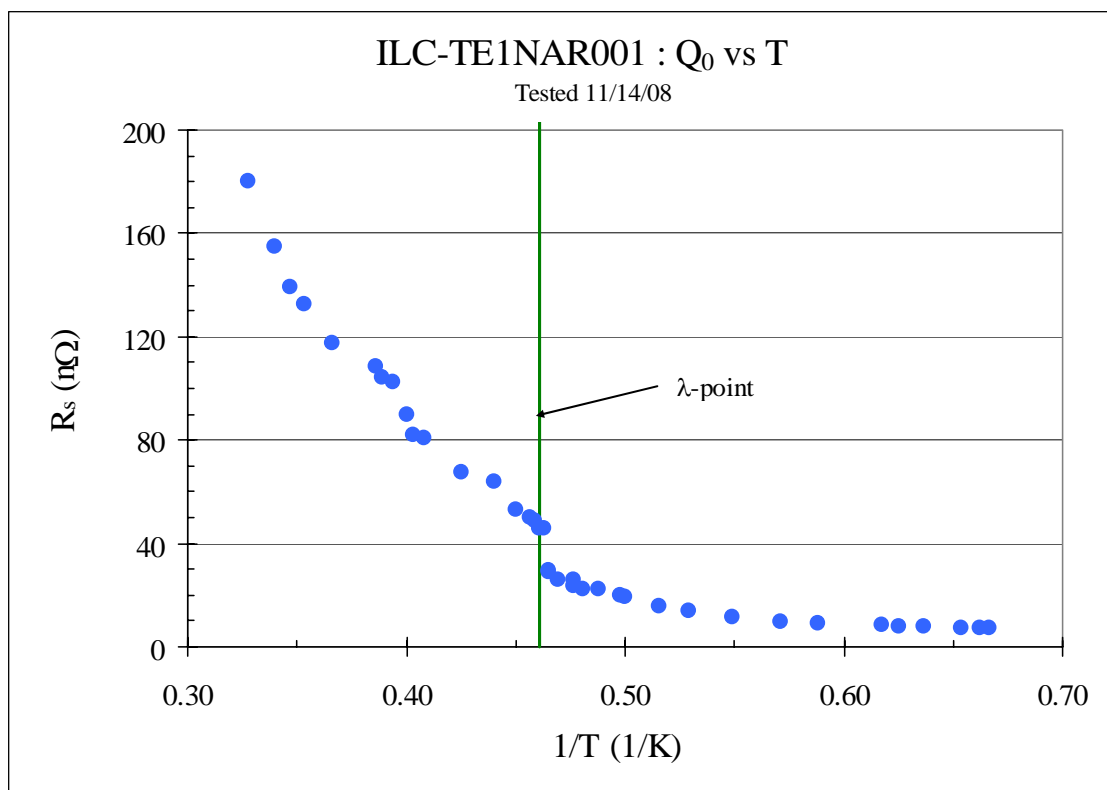


Figure 3.) R_s vs T, around the λ -point.